British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Canna Multibeam Survey on the Northern Lighthouse Board vessel, Polestar.

BGS Survey - 2011_7

1st – 11th July 2011

Marine Programme

Internal Report OR/11/045

BRITISH GEOLOGICAL SURVEY

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Rhys Cooper, Nick Smart

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Foreword

The British Geological Survey (BGS), Northern Lighthouse Board (NLB), Scottish Natural Heritage (SNH) and Marine Scotland (MS) have signed a Memorandum of Understanding (MoU) to collect and share multibeam bathymetric data. Two BGS Hydrographic Surveyors, Nick Smart and Rhys Cooper, were assigned to the Northern Lighthouse Board (NLB) vessel, Polestar, in Oban to undertake a Multibeam bathymetric survey around the Isle of Canna between the 1st July and 11th July 2011. Laura Clark from SNH was also onboard.

The Polestar's survey system had been tested earlier in the year during a trial survey in the Oban bay area (BGS survey number 2011_2).

Acknowledgements

A number of individuals in the Northern Lighthouse Board and BGS have contributed to the project. This assistance has been received at all stages of the study. In addition to the collection of data, many individuals have freely given their advice, and provided local knowledge.

Of the many individuals who have contributed to the project we would particularly like to thank the following:

Mike Spain (NLB)

Stuart Ross (NLB)

NLB Polestar crew members, officers and mates.

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1 Introduction

The British Geological Survey (BGS), The Northern Lighthouse Board (NLB) and Scottish Natural Heritage (SNH) are part of a collaboration to collect multibeam bathymetry. Two BGS Hydrographic Surveyors, Nick Smart and Rhys Cooper boarded the Polestar along with Laura Clark from SNH on the 1st of July to carry out a survey around the Isle of Canna on the west coast of Scotland. The survey extent was designed to fit in with pre-existing areas surveyed as part of the Marine and Coastal Agency Civil Hydrography Programme (CHP). The survey finished on the 11th of July, allowing only 10 days to complete a significant area (approximately 300km2).

The Polestar is a Medium Buoy Tender and has served the NLB since 2000. It has an overall length of 51.52m, width of 12 meters whilst only drawing 3.46m. The Polestar has Dynamic Positioning capabilities (DP), allowing precise and accurate manoeuvres (nlb.org.uk 2009)

Figure 1: NLB Polestar (NLB 2009).

1.1 SURVEY AREA

Figure 2: Multibeam data collected on NLB Polestar around Isle of Canna, 1-11 July 2011.

2 Mobilisation and Survey

BGS Hydrographic Surveyors had previously conducted a test survey onboard Polestar during two periods during February and March 2011. Due to the success of these test periods, minimal mobilisation time was needed prior to departure from Oban to Canna.

The only major problem encountered was sourcing a suitable shore based tide gauge. A Valeport 740 was hired from Sonar Equipment Services, however, due to a software fault this was not shipped in time. A last minute replacement was hired from DPS-Offshore, this was a Valeport Midas Water Lever Recorder. A Tide Master would have been more suitable due to its functionality and size. The sensor was installed at Canna ferry jetty. Full deployment details can be found in section 2.2.

With minimal time for the survey, a patch test was not performed as the results from the calibration performed by BGS surveyors in February were deemed acceptable. Due to the sonar head being hull mounted, it was safe to assume that no movement had occurred since the test period. Full patch test details can be found in Appendix 2.

The survey area was divided into smaller manageable sections, the survey commenced with an aim to run at least 25% overlap. This was to ensure a minimal IHO order was reached, but also to ensure the maximum area was covered with only 10 days available. It was the first time the majority of the crew had run survey lines so gaps were present, an effort was made to go back and fill in the larger gaps, however, it is likely that some were missed.

2.1 TIDE GAUGE SET-UP

Accurate tidal information is critical for multibeam survey operations. A Valeport Midas WLR gauge was hired from DPS- Offshore in Aberdeen after the failure of another supplier to deliver a shore based 740 on time. Although not as suitable as the shore based equivalent, the WLR gauge is small enough to deploy and has a long battery life making it suitable to deploy and leave for duration of survey. Tide was measured in 15 second burst and logged every minute to a text file, providing a continuous record during all survey operations. Tide data was retrieved on the final day of survey.

The quayside at Canna was deemed the most suitable location to install the tide gauge as it was secure, stable, easily accessible, and importantly did not dry out at low tide. It was not possible to undertake any reconnaissance prior to survey and time was extremely limited to set-up and monitor gauge. Although not ideal, the best solution was found given the resources available.

It was possible to measure the tide gauge height and reference this to chart datum. The Admiralty chart for this area notes that Chart Datum for Loch Harport is 2.6 m below Ordnance Datum Newlyn. Loch Harport was the nearest location where a CD to OD Newlyn offset could be found. Using ellipsoidal height and VORF (Vertical Offshore Reference Frame, provided by UKHO) the height of tide gauge relative to CD was calculated.

2.1.1 Tide gauge set-up

Tide gauge height relative to chart datum was determined using a Leica GPS500 system, Leica Geo Office software and the freely available RINEX data from the Ordnance Survey website.

The tide gauge was deployed from the Canna jetty. To maintain its position a clump weight was attached to the frame work surrounding the gauge. Nylon rope was tied to the weight to aid in deployment and recovery. The offset of the gauge to the top of the jetty was measured using a standard 30m roll of measuring tape. Five metre intervals were marked out on the rope to allow exact final measurement to quayside.

The GPS antenna was positioned on the quayside using a level tripod and tribach, its position was logged for 2 hours.

The logged data was then downloaded into Leica GeoOffice to allow the application of RINEX differential corrections, freely available from the Ordnance Survey Active GPS network RINEX data server website (http://gps.ordnancesurvey.co.uk/active.asp). Web access was possible using the vessels satellite communications.

For more information on the National GPS Network follow this link.

http://www.ordnancesurvey.co.uk/oswebsite/gps/osnetfreeservices/about/overview_osnet.html

Figure 3: Leica GPS setup.

The logged data could then be corrected to provide an accurate position and height to approximately 1cm accuracy.

Using VORF the exact height of the tide gauge relative to Chart Datum was determined.

Table 2: GPS logging summary

Date/Time	Easting	Northing	Ellipsoid Height	Position + height quality	Orthogonal Height (ODN)	Comments
01/07/2011 18:13:45	127827.1113	805046.1638	58.6500	0.0094	2.8082	Logged for 2 hours.

Ellipsoid Height entered in VORF (positive down)	Height of Quay relative to CD (from VORF)	Tide gauge below quay	Tide Gauge height relative to CD
-58.65m	5.0315m	7.26m	-2.2285m

Below is a schematic summarising the heights from the first period’s observations:

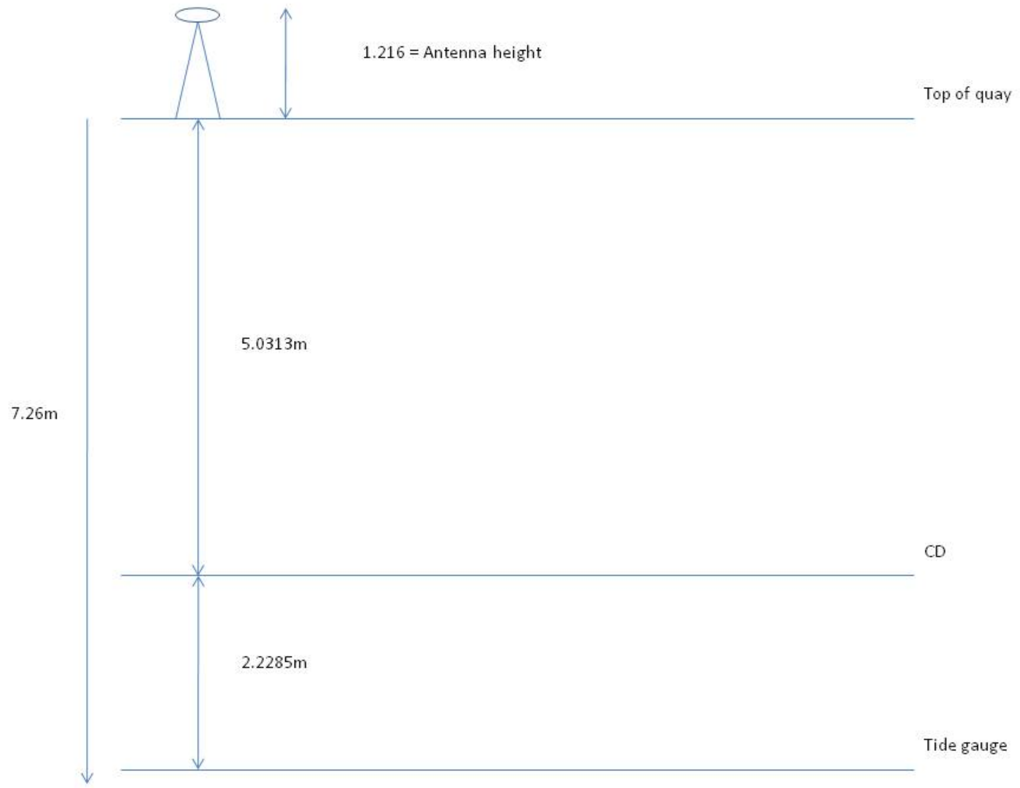


Figure 4: Height level diagram in meters for Canna jetty. The antenna height, chart datum/ODN difference and top of quay to tide gauge measurements were already known. Leica Geo Office was used to convert ellipsoid heights to ODN heights, and VORF to determine a level below chart datum.

2.1.2 Tide gauge issues

The original intention was for the tide to be deployed on the night of the 1st July. Difficulties in setting the gauge up and deploying at Canna jetty prevented this. Without knowing if the problems could be rectified it was deemed essential to start the survey and in a worst case scenario only use predicted tides.

The initial problems with the tide gauge set-up and deployment were solved and the gauge was in place and recording data the following morning. This left a period of time where real time tide data was not available (00:33:55 02/07/11 – 16:52:00 02/07/11). In order to overcome this, the predicted tides for this period were compared to the same epoch of Canna jetty tides collected. The average of the difference over the whole survey period could then be calculated for each 5 minute tidal measurement and applied to the predicted tides used when the gauge wasn't in place.

2.2 SURVEY OPERATIONS

Offshore operations were 24 hours with two crew members and one surveyor on the bridge at all times.

No fixed line plan was created prior to operations. A survey plan was developed with the Captain with lines being run with approximately 25% overlap of each adjacent lines swath width, the priority of survey being to cover the greatest area possible with limited time. The survey area was relatively shallow survey depth and only in small areas of deeper water or poor steerage did this become an issue. Some gaps are inevitable due to the low level of overlap and rapidly changing sea floor topography. For the majority of crew, this was the first time undertaking a multibeam survey.

Sound velocity profiles were taken at least once every 12 hour shift or whenever the SIS warning light indicated values were out of range, SV appeared relatively stable in the survey area only changing by 3-4m/s throughout the course of a shift.

Tide gauge data was collected at the end of the survey and downloaded to the CARIS processing PC.

2.3 SURVEY ISSUES

The following table gives a summary of the issues encountered. Full details of all issues that occurred and solutions applied can be found in the Daily Log, Appendix 8.

Table 1: Summary of issues encountered onboard.

Issues encountered	Solution	Reasoning
Valeport Midas 740 not logging correct date or any pressure reading.	With daylight hours limited the gauge was taken back to the boat and tested. The set-up parameters were altered and the gauge made ready for deployment following morning	Not entirely sure of cause, but gauge deployed successfully with only 12 hours of data effected. Predicted tides will be used and adjusted accordingly (see below for more details)
Canna jetty tide gauge deployment. The sizeable Midas WLR and a very rocky bottom made locating the gauge sensor problematic.	The sensor was heavily weighted and deployed from work boat about metre away from jetty edge on a flat area of seabed. With limited time it was essential to not lose too much survey time whilst installing gauge.	It is better to have a tide gauge deployed than none at all. Any error in tide gauge level incurred by moving slightly away from levelled jetty deemed less than relying solely on predicted tides.

Power outage on Polestar causes loss of readings from SV sensor at heads	Changed com port back to original setting.	Not entirely sure of reason for change of com port setting.
Several SIS crashes	Restart – potential option to update software. Decided not too due to limited time and previous issues with new versions of SIS. A new version will be installed for the next survey.	Accepted as an inevitable part of running SIS on an older software version.
SIS not displaying background grid data when over a certain size	Only load essential grids	This was a known issue to Kongsberg.

2.4 DATA PROCESSING

All data processing was conducted in accordance with the standard UKHO SOP for Kongsberg Maritime MBES Data in CARIS HIPS and SIPS.

The Simrad raw .all files were imported in to CARIS HIPS using the Conversion Wizard. To ensure that there were no major artefacts or other issues within the acquired data, a Base Surface was generated for initial QC purposes and evaluated using the CARIS Subset and Swath Editors. Cleaning of the soundings was performed using a mix of the Combined Uncertainty and Bathymetry Estimator (CUBE) algorithm within CARIS and manual edits/examination. Upon satisfactory production of a CUBE surface at 2m resolution, soundings that significantly deviated from the surface were rejected.

2.5 DE-MOBILISATION

Demobilisation occurred on the 11th July 2011. At 06:00 in the morning the tide gauge was recovered and data downloaded. The Polestar then made its way to Stornoway where Nick Smart, Rhys Cooper and Laura Clark all departed.

3 Survey Equipment

3.1 NAVIGATION

Navigation was provided by an Applanix POS MV 320 with DGPS corrections from a Fugro SeaSTAR receiver. Associated antennas were at the top of the main mast, the SeaSTAR receiver was placed on the bridge, with the POS MV unit placed in the level one office.

3.1.1 POS MV 320

The POS MV 320 system is a GPS aided inertial navigation system which provides accurate attitude, heading, heave, position and velocity data with the aid of inertial GPS. The unit was running with POS View V5.05 software and firmware with Trimble BD960 GNSS V4.02 firmware.

Figure 5: POS MV PCS and Inertial Measurement Unit (Applanix 2009).

The POS MV consists of the above components, the POS computer system (PCS) and the Inertial Measurement Unit (IMU). The processor software functions include the Strapdown Inertial Navigation Algorithm to compute velocity, roll, pitch and true heading from the accelerometer and gyro outputs, a Kalman filter that estimates long term drift in the inertial solution using GPS aiding measurements, and an error corrector that applies the Kalman Filter estimates to the strap-down navigator to continually calibrate the inertial sensor. The PCS also contains a GPS Azimuth Measurement Subsystem for computing true heading from carrier phase measurements output by the dual GPS receivers. The processor firmware and software provide sensor calibration, and also fault detection, isolation and automatic reconfiguration (Applanix 2008).

The POS MV was receiving RTCM type 1/9 corrections from the Fugro SeaSTAR 3510R receiver over a D type 9 pin serial connection. The POS MV output an $INGPGGA string to the EM3002D PU plus Kongsberg proprietary data string for attitude data. A PPS was also utilised between the POS MV and the PU to synchronise timing.

The table below shows expected accuracies:

Table 3: Accuracies of the POSMV 320 (Applanix 2009).

PERFORMANCE SUMMARY - POS MV Accuracy

POS MV 320	DGPS	RTK	GPS Outage
Position	0.5 - 2 m[1]	0.02 - 0.10 m[1]	<2.5 m for 30 s outages, <6 m for 60 s outages
Roll & Pitch	0.020°	0.010°	0.020°
True Heading	0.020° with 2 m baseline 0.010° with 4 m baseline	-	Drift less than 1° per hour (negligible for outages <60 s)
Heave	5 cm or 5%[2]	5 cm or 5%[2]	5 cm or 5%[2]

3.1.2 SeaSTAR 3510r

This receiver will output a range of Fugro raw data options and calculates RTCM corrections for the user’s location; it is designed for use with an external GPS receiver.

Figure 6: SeaSTAR 3510R, image courtesy of (SeaSTAR 2004).

Further spec details of both SeaSTAR and POSMV can be found at ReportAndDeliverables\Documents\SeaSTAR 3510_nov04.

3.2 GEOPHYSICAL SURVEY EQUIPMENT

3.2.1 Kongsberg EM3002D Multibeam Echo sounder

The EM3002D is a dual-headed system capable of producing up to 508 dynamically focused beams; this produces a swath width of up to 200° operable in depths of up to 150 m. The system operates in the 300 kHz frequency range, which ensures narrow beams and a small acoustic footprint, and is also robust under conditions with high particle content in the water column.

The EM3002D uses a powerful processing unit and two compact sonar heads. The processing unit applies sophisticated processing algorithms for beam forming, beam stabilisation and bottom detection.

Information from the processing unit is sent to an operator station running Windows XP, from where the surveyor can operate the system and adjust settings accordingly within the Seafloor Information System (SIS). SIS has extensive functionality such as 3D graphics and real-time data cleaning.

Position and attitude information for the EM3002D is provided via the POS MV. This incorporates a motion reference unit and position antennae, a combination of which positions and measures the attitude of the vessel. All of this information is tagged to the data to provide a real-world position.

Figure 7: Blister mounting of EM3002D sonar heads on the hull of the Polestar.

CABLE LAYOUT

Below is a schematic showing cable runs between the equipment involved:

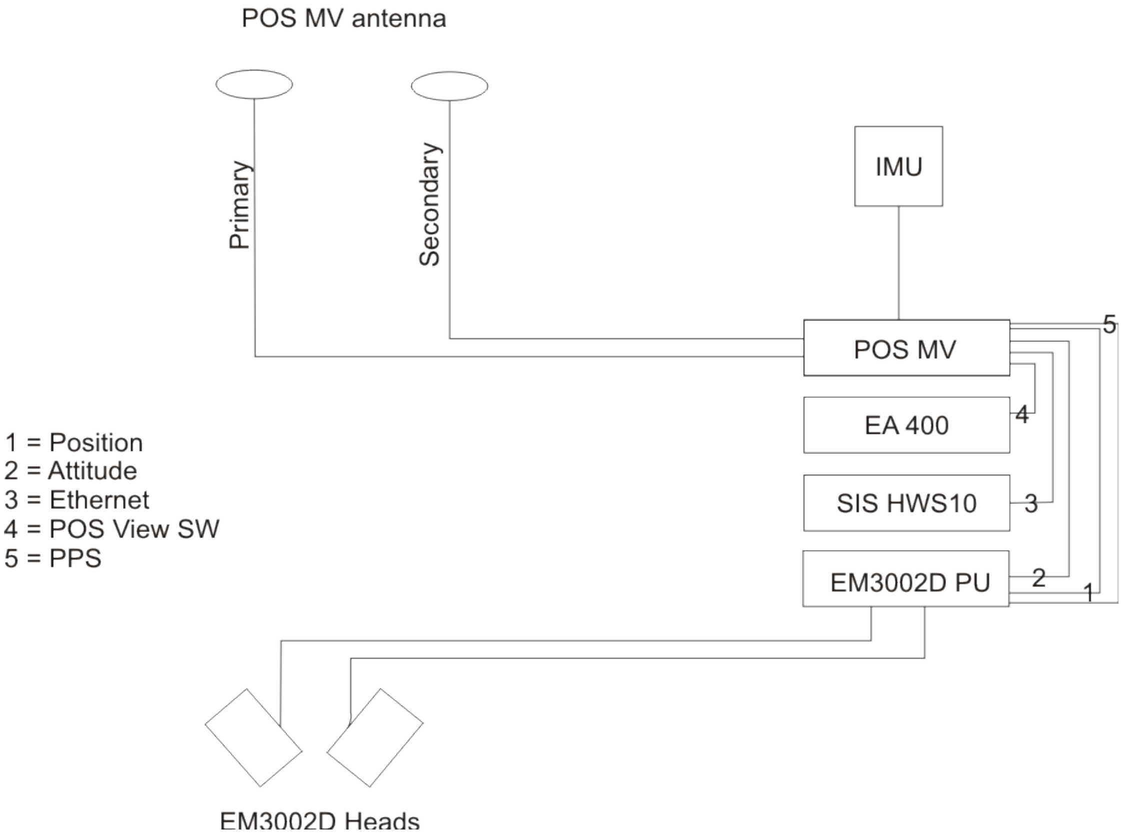


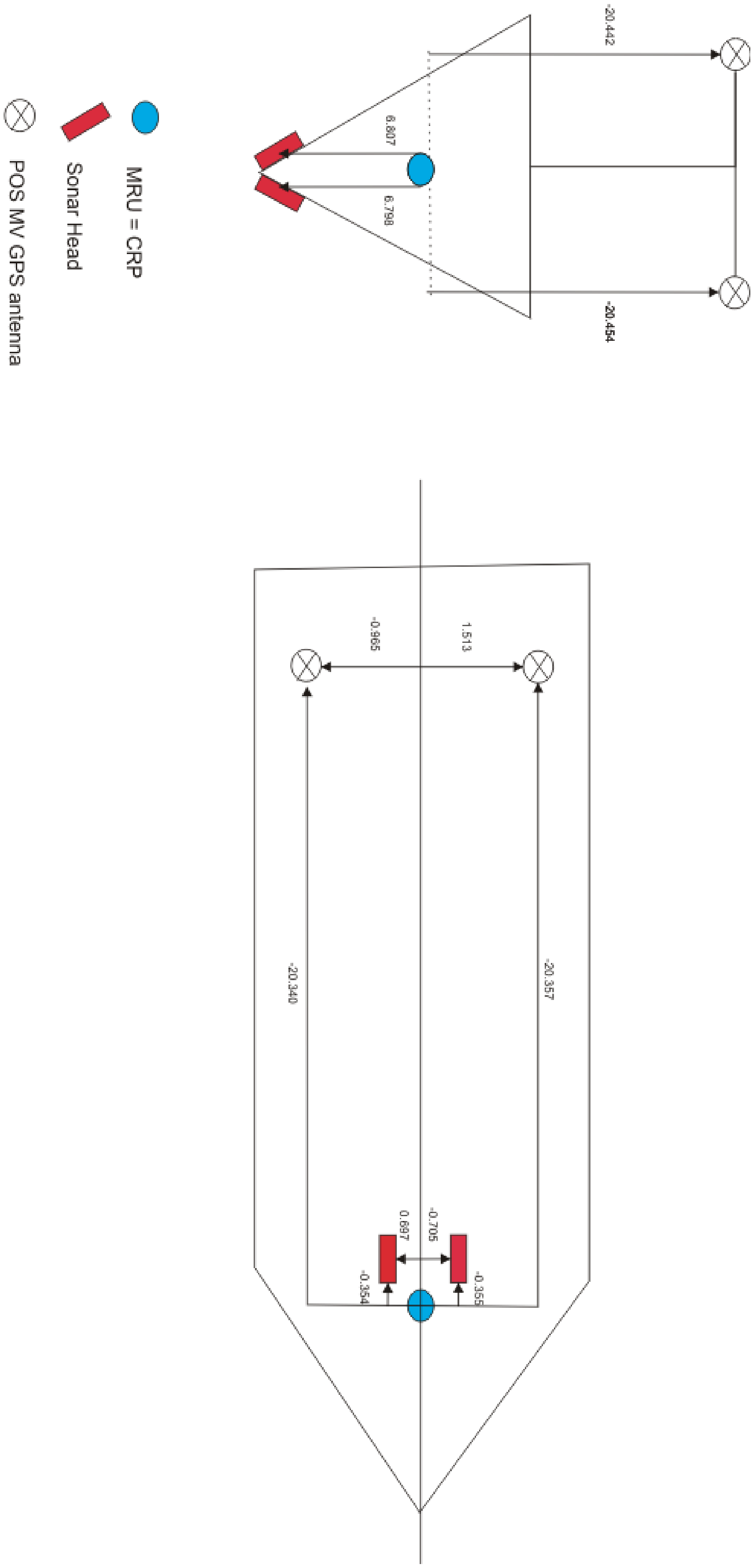
Figure 8: Schematic showing multibeam cable layout.

Appendix 1 Personnel

BGS personnel: Nick Smart and Rhys Cooper.

Scottish Natural Heritage (SNH): Laura Clark

Equipment Offset Diagram



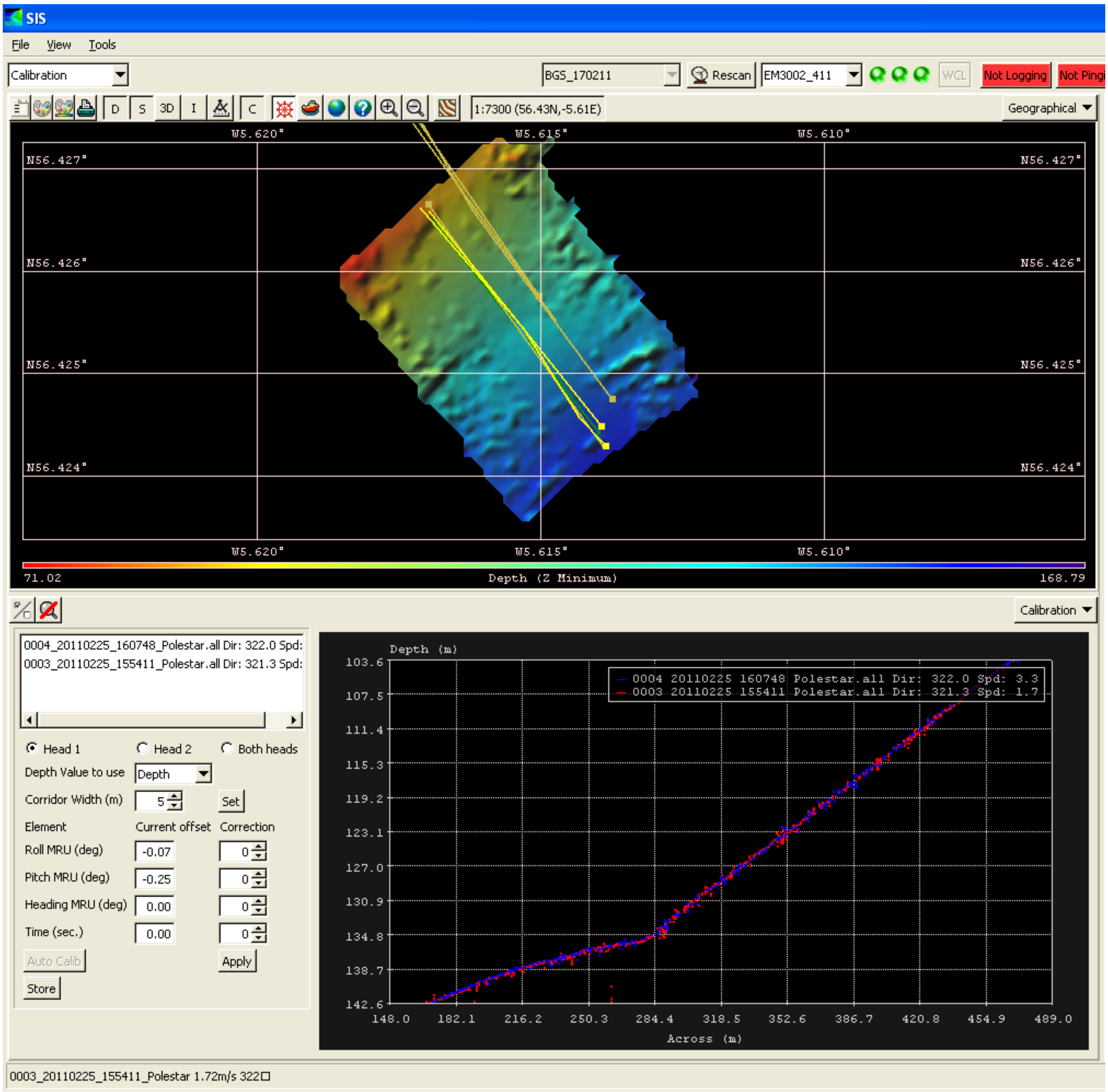
Appendix 2 Patch test

Patch test for NLB Polestar.

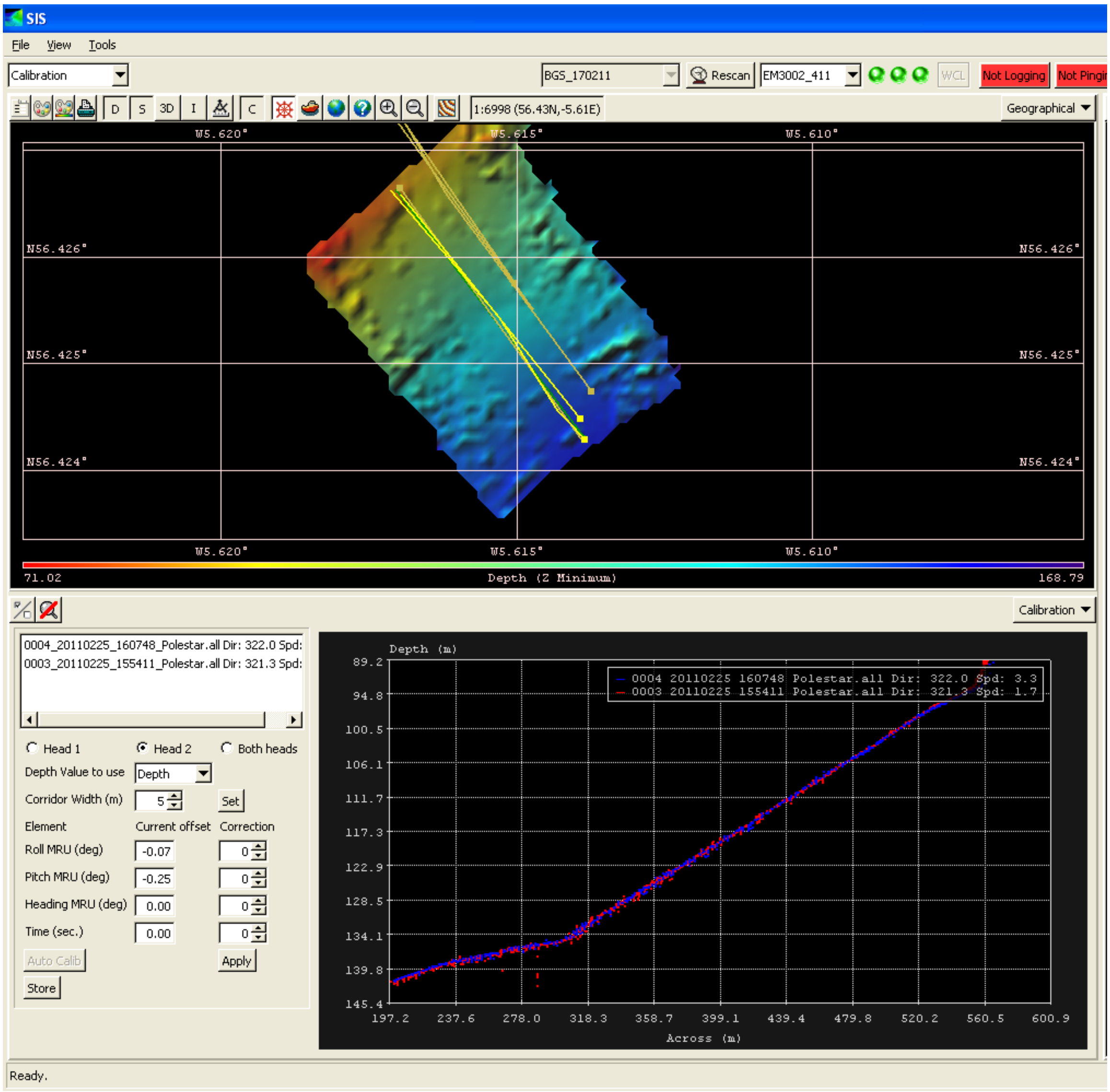
A patch test was carried out on board the NLB vessel Polestar on the 25/02/11 by BGS surveyors.

The results can be seen below. Roll was the only parameter that needed an offset corrected for.

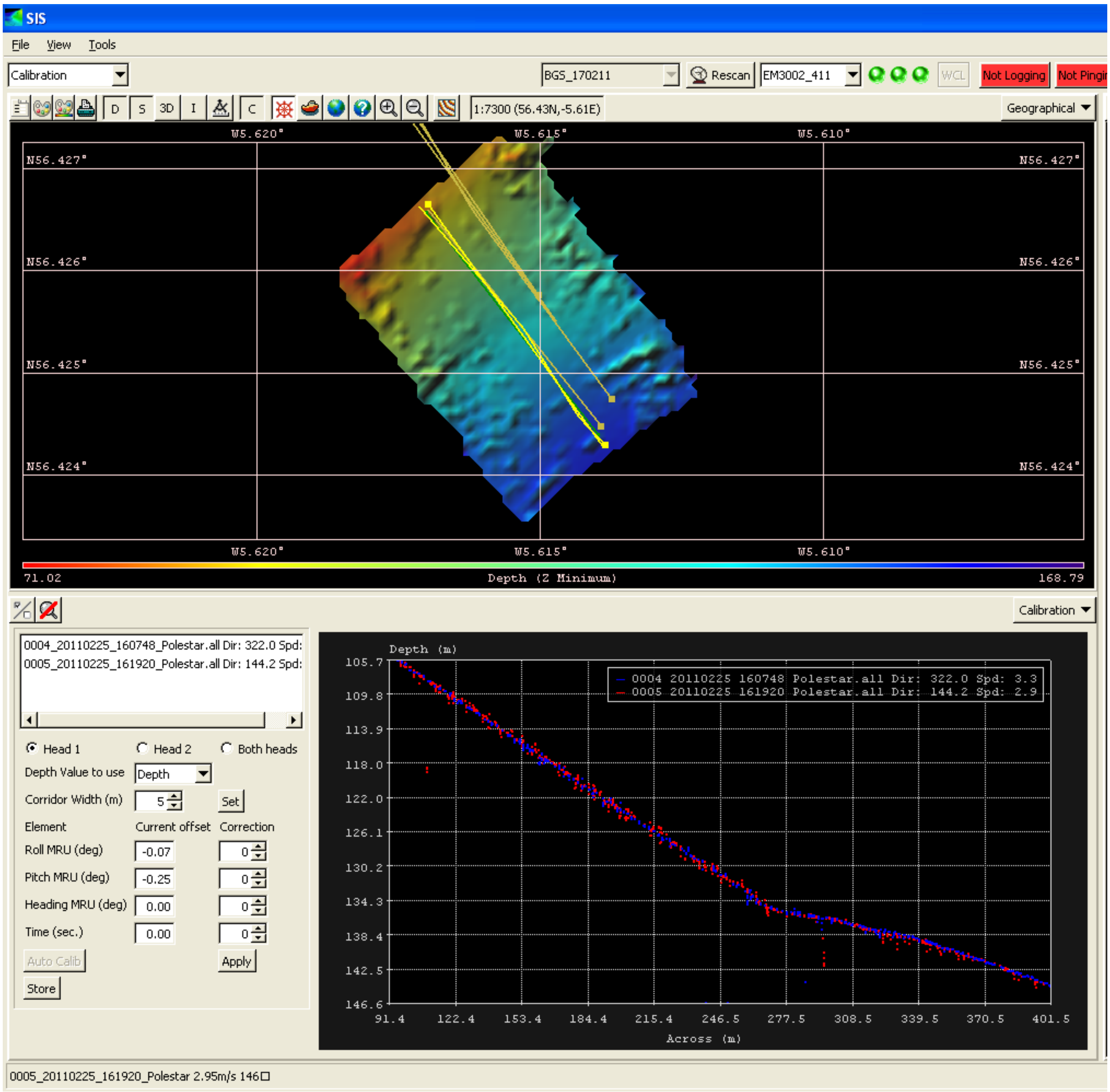
<u>Latency – Head 1</u>



Latency – Head 2



Pitch – Head 1


SIS
File View Tools
Calibration
BGS_170211
Rescan
EM3002_411
WCL
Not Logging
Geographical
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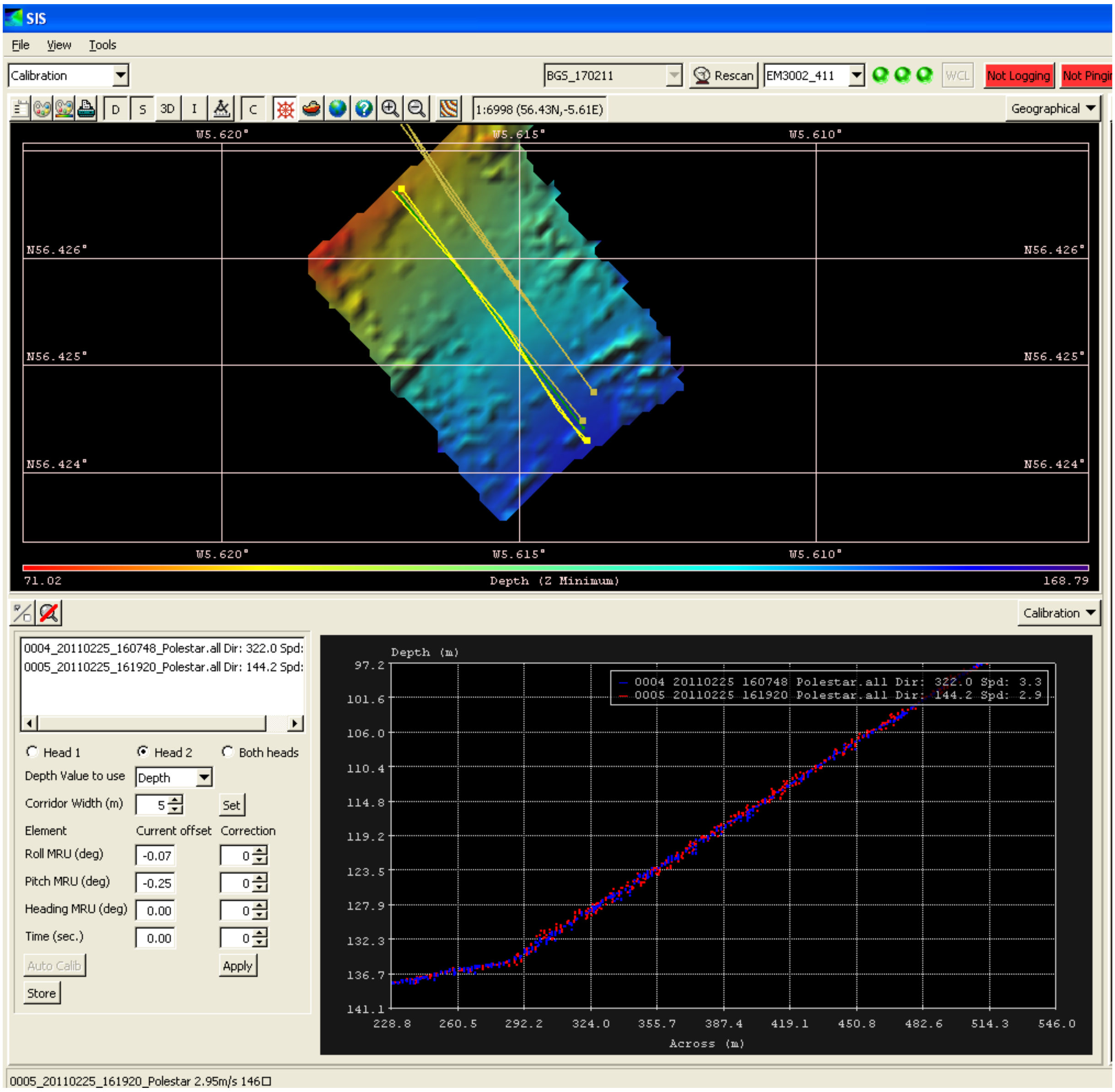
W5.620° W5.615° W5.610°
N56.427°
N56.426°
N56.425°
N56.424°
71.02
Depth (Z Minimum)
168.79
Calibration
0004_20110225_160748_Polestar.all Dir: 322.0 Spd:
0005_20110225_161920_Polestar.all Dir: 144.2 Spd:
Head 1
Head 2
Both heads
Depth Value to use
Depth
Corridor Width (m)
5
Set
Element
Current offset
Correction
Roll MRU (deg)
-0.07
Pitch MRU (deg)
-0.25
Heading MRU (deg)
0.00
Time (sec.)
0.00
Auto Calib
Apply
Store
Depth (m)
0004 20110225 160748 Polestar.all Dir: 322.0 Spd: 3.3
0005 20110225 161920 Polestar.all Dir: 144.2 Spd: 2.9
105.7 109.8 113.9 118.0 122.0 126.1 130.2 134.3 138.4 142.5 146.6
91.4 122.4 153.4 184.4 215.4 246.5 277.5 308.5 339.5 370.5 401.5
Across (m)
0005_20110225_161920_Polestar 2.95m/s 146

Pitch – Head 2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N56.426°
N56.425°
N56.424°
71.02
Depth (Z Minimum)
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Calibration
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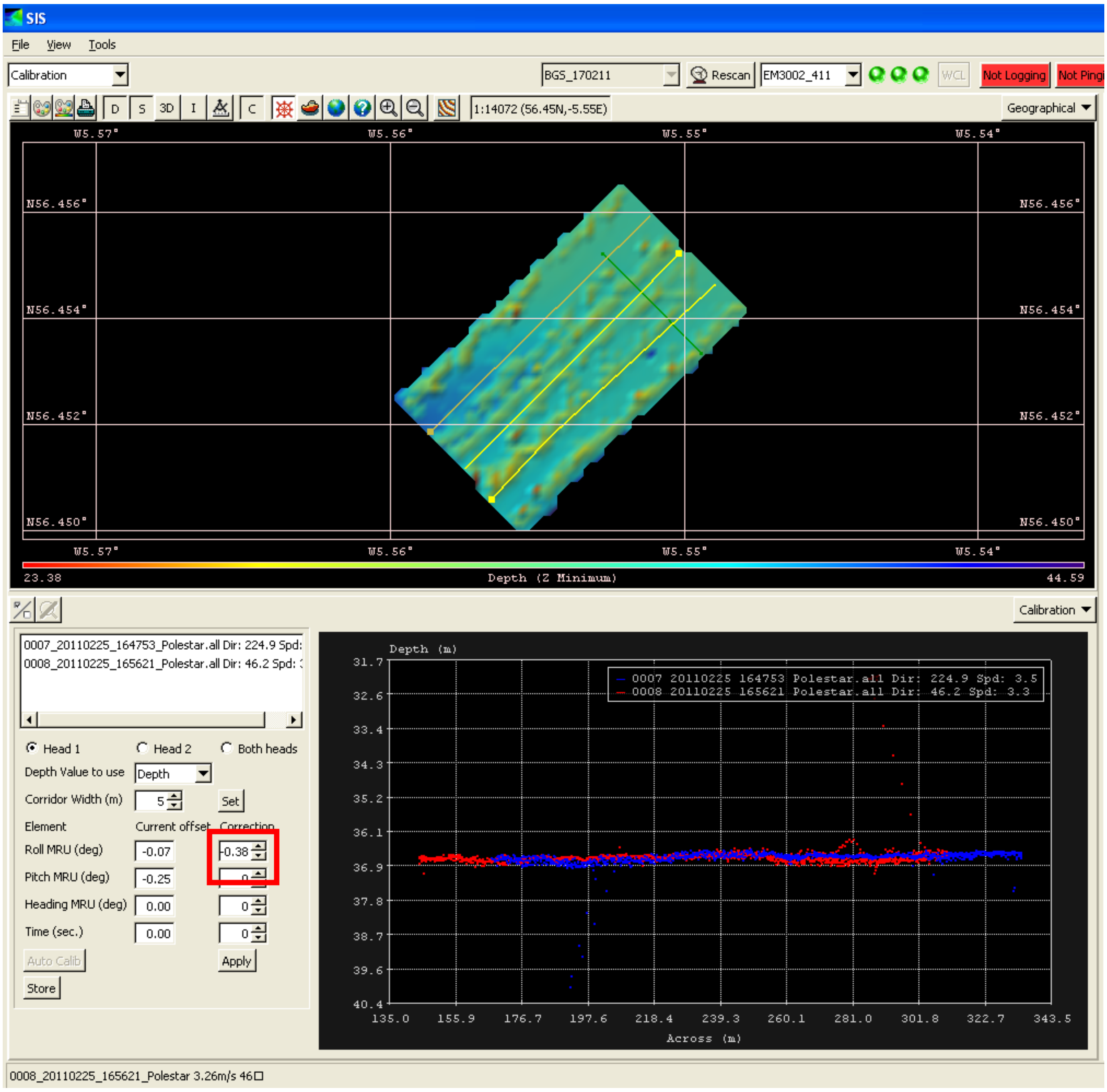
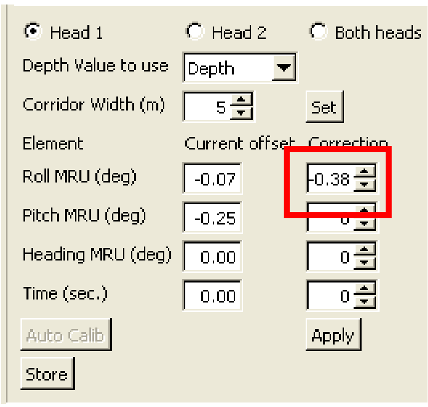
0005_20110225_161920_Polestar.all Dir: 144.2 Spd:
Head 1
Head 2
Both heads
Depth Value to use
Depth
Corridor Width (m)
5
Set
Element
Current offset
Correction
Roll MRU (deg)
-0.07
Pitch MRU (deg)
-0.25
Heading MRU (deg)
0.00
Time (sec.)
0.00
Auto Calib
Apply
Store
Depth (m)
0004 20110225 160748 Polestar.all Dir: 322.0 Spd: 3.3
0005 20110225 161920 Polestar.all Dir: 144.2 Spd: 2.9
97.2 101.6 106.0 110.4 114.8 119.2 123.5 127.9 132.3 136.7 141.1
228.8 260.5 292.2 324.0 355.7 387.4 419.1 450.8 482.6 514.3 546.0
Across (m)
0005_20110225_161920_Polestar 2.95m/s 146

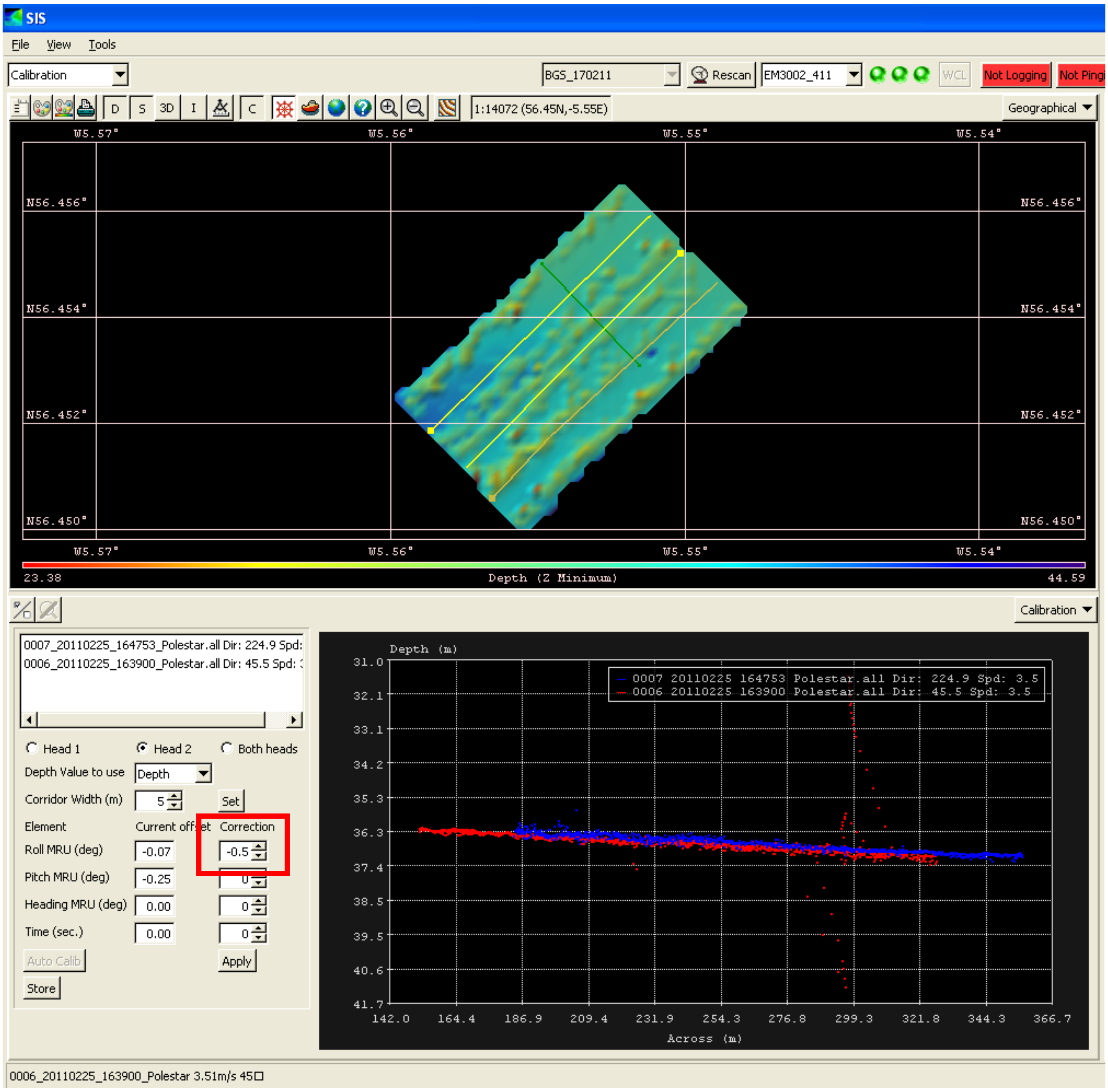
Roll - Head 1



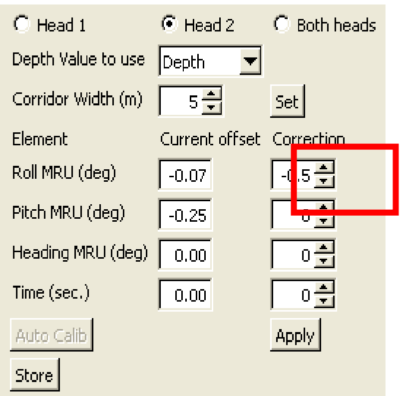
Head 1 correction needed:



Roll - Head 2



Head 2 correction needed:



Roll correction application:

Head 1 = -0.38

Head 2 = -0.5

Common Error (CE) = (-0.38+-0.5)/2 = -0.44

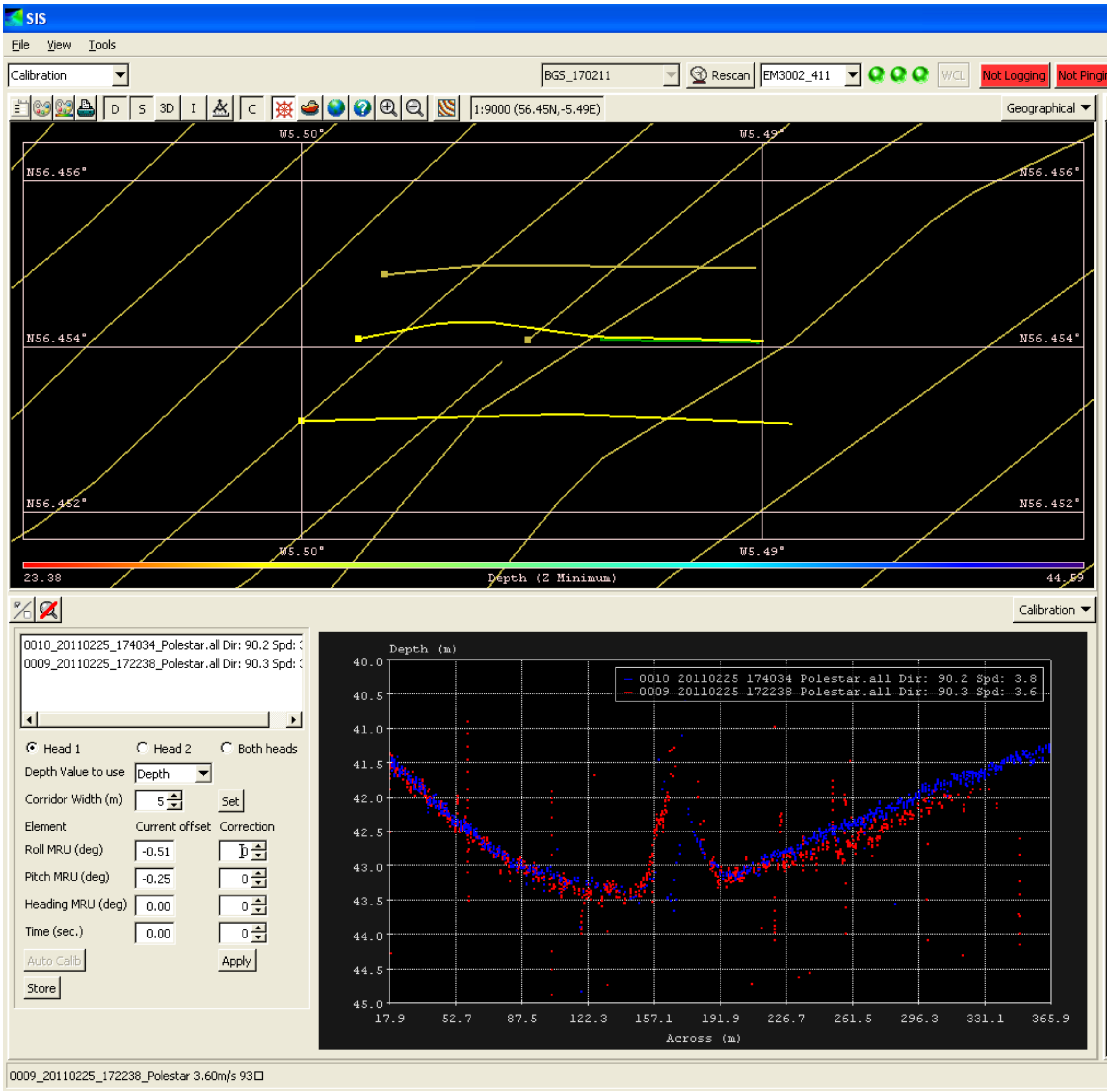
Head 1 correction = +0.06

Head 2 correction = -0.06

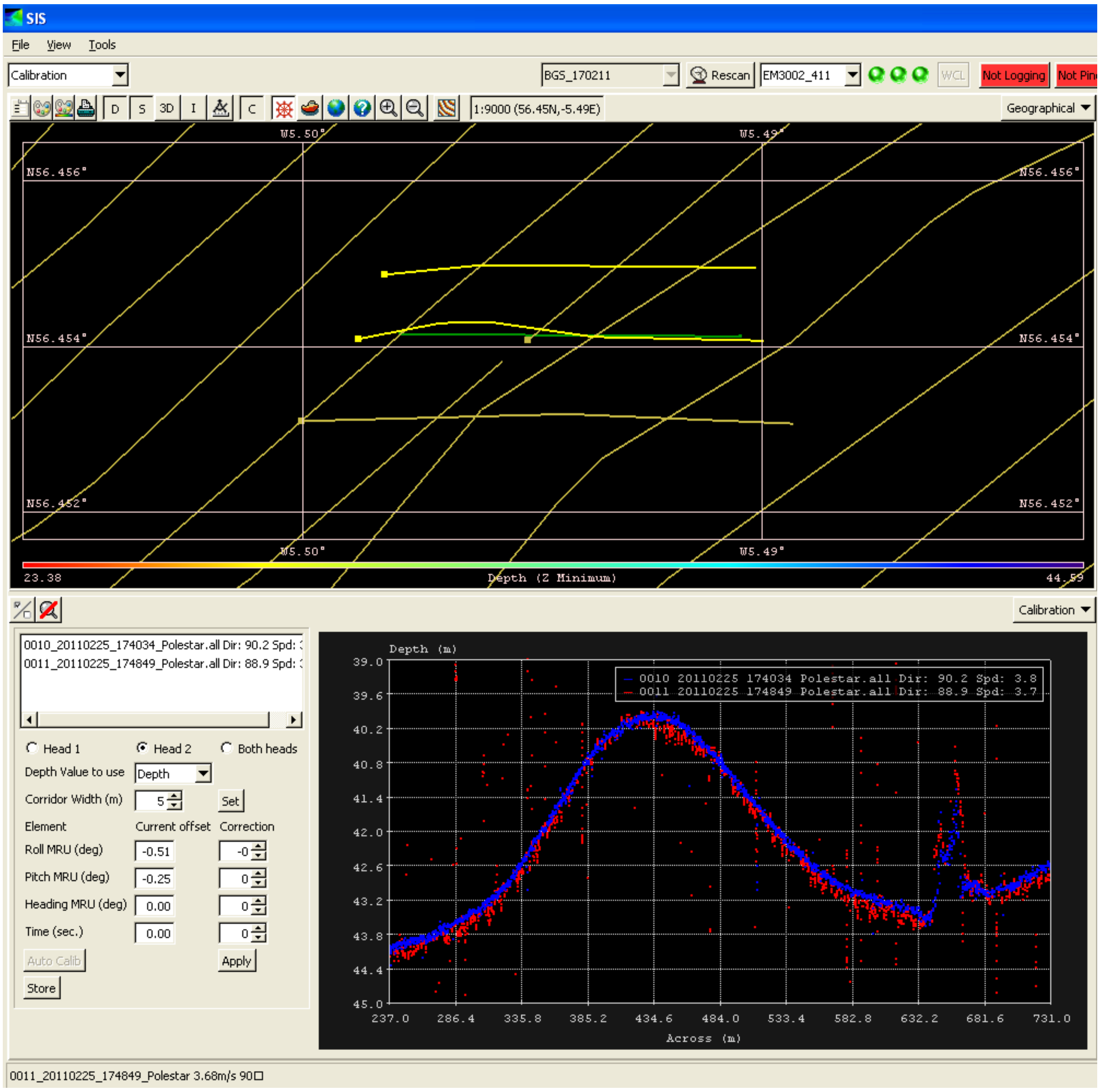
Head 1 installation = 39.345

Head 2 installation = -38.515

Heading – Head 1



Heading – Head 2



There were no corrections required for latency, pitch or heading.

Appendix 3 Daily Log

<u>01/07/11</u>

Depart Edinburgh by train to Oban. Arrive NLB at 11:30.

Tide gauge delivered by Thistle Couriers from DPS Offshore at 10:30.

Laura Clark arrives 13:00.

Depart for Canna 13:10.

Arrive Canna 18:30

Tide gauge installation on Canna.

Jetty level determined using Leica GPS 500 system. Data logged from 19:00-21:00.

Tide gauge not logging date correctly and need to re-think installation of gauge on sea floor due to rocky/boulders around jetty.

Return to ship to commence survey.

Power surge causes computers to crash causes issues with SV probe at head.

<u>02/07/11</u>

SVP probe 00:15

Survey started at 01:44 GMT (all times GMT from now on)

SIS crashed twice during day.

Tide gauge logging issues sorted and installed at 16:00.

SVP probe 15:17

Lines 1-46 completed.

<u>03/07/11</u>

SVP probe 12:15

Continue survey lines.

Height of tide gauge determined using Leica Geo Office.

Processing commences.

Grids on geographical tear off not displaying – logged off line 77 - SIS Crash 17:30ish.

Restart – on line 78

No grid on SIS – carry-on with coverage lines

<u>04/07/11</u>

New job made in SIS, still no coverage from previous lines, seabed now staying on screen with new lines.

01:43: deep water, 170m+ so slowed to 5knots to try and improve bottom tracking. Struggling on slopes 50 – 200m

Slowed to 4.5knts in 200m, better bottom tracking.

02:15 SVP taken

02:40 lots of port head noise – depth associated

04:20: bottom tracking lost.

12:00 – Lines 114-124 – filling in gaps

13:52 – Recommence survey, northern part. Depths over 160 unreliable –stopped at ~180m

21:30 – SVP probe

<u>05/07/11</u>

00:00 Continuing lines in the western part of survey area over deeper areas.

Lost grid again, new job to be made before heading south.

07:30 heading south/east to work in shallows.

08:20 running line 162 south to create a border of extents.

Sis crash 09:30

SIS crash 09:31

09:37 line restart

SIS error msg when trying to load grids from previous days? Grid engine failed to run? Need a SIS update.

14:00 SIS crash

<u>06/07/11</u>

Bottom tracking lost on 14m pinnacle, run over again.

01:20 SVP

01:25 SIS crashed

02:30 SIS crash

03:06 SIS crash

12:00 cont with survey filling lower section

Continue filling holes.

Finnish 23:46 – heading back to Oban for crew change

<u>07/07/11</u>

Arrive Oban 07:30, Processing.

Depart Oban 16:30

Arrive Canna 21:50

SVP probe 22:00

Start line 261 – 22:16, 21:16 GMT

080711

02:50 crash on line 277

Moved to shallow area

SVP – 12:50

Darkness – moving to deeper area

090711

Sis crash 01:24

Crash 01:26

03:33 running lines on east of area, over 150m so speed drop to 4-5knots

04:12 struggling with bottom tracking in deep water.

Sis crash 05:36

06:31 sis crash

08:35 sis crash

Lots of line filling in south shallow area.

10:30pm moved to deep water to finish eastern edge.

SVP probe on arrival ~2300 – changed battery in probe as not working,

Started in deep area east. Too deep 190m. – 200m

100711

SIS crashed 23:14

Sis crash 23:47

Line 382 ended due to bad data, 200m

Line 383 bad quality due to depth. Won't get past 200m

Crash 05:12

Line 394 filling in dropouts.

End of survey 04:30

Heading to Canna to retrieve tide gauge.

Figure 8: Schematic showing multibeam cable layout.

Appendix 4 Initial Risk Assessment

3.2.1.1 NAME OF SHIP POLE STAR **Record no. 027**

Work Area being assessed **Deck Third Party Personnel**

Task Id number	Work process/action undertaken in area	Hazards associated with activity	Controls already in place	Significant risks identified	Further assessment Required (Y/N)
1	All Areas of the Ship	Recognition of Shipboard Hazards by Third Party Personnel	Familiarisation Tour and under the supervision of Ships Staff	None	No
2	All areas of the Ship	Third Party Equipment Failure	Must meet NLB Standards	None	No
3	All Areas of the Ship	Position and securing of Third Party Equipment	To be approved by Ships Staff	None	No
4	All Areas of the Ship	Personnel Injury	Appropriate PPE gear to be worn. Ship Task specific Risk Assessments to be Followed	None	No

Declaration:

Where no significant risk has been listed, we as assessors have judged that the only risks identified were of an inconsequential nature and therefore do not require a

more detailed assessment.

Signed ______________S.S.Tyler____

References

APPLANIX. [2009]. http://www.applanix.com/products/marine/pos-mv.html [online]. Last update 2009 [cited 14 March 2011].

APPLANIX. [2009]. http://www.applanix.com/media/downloads/products/specs/posmv_specifications.pdf [online]. Last update 2009 [cited 14 March 2011].

FUGRO SEASTAR. [20045]. http://www.seastar.co.uk/Support/Seastar%203510_nov04.pdf [online]. Last update Nov 2004 [cited 14 March 2011].